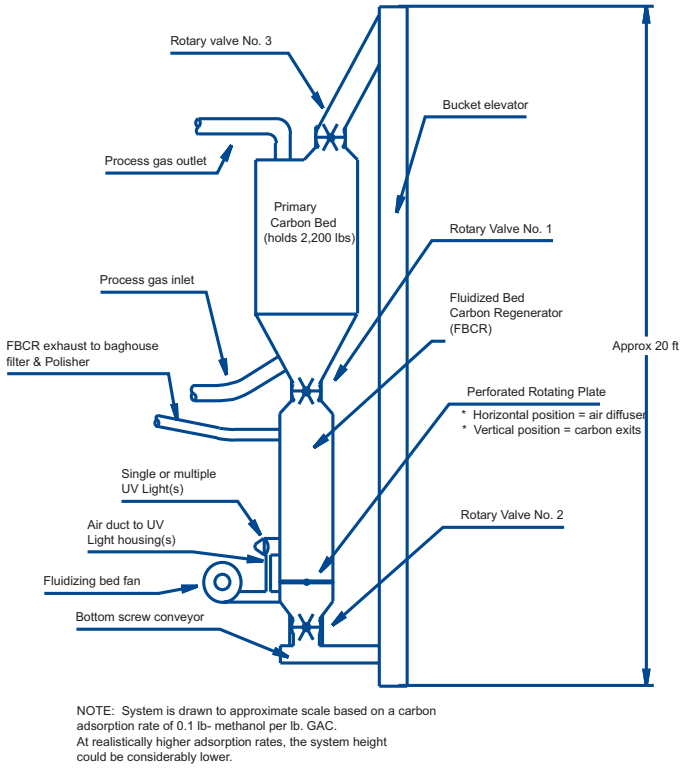
Industrial Technologies Program

An Innovative Titania-Activated Carbon System for Removal of VOCs and HAPs with In-Situ Regeneration Capabilities

Cost-effective, energy-efficient titania-coated activated carbon system promises effective removal of VOCs and HAPs from air streams

Manufacture of forest products produces unwanted by-products, such as Volatile Organic Compounds (VOCs) and Hazardous Air Pollutants (HAPs). Effective control of these emissions is essential to the continuing development of the forest product industry. Currently, ex-situ thermal oxidation is the most commonly applied technique for the control of VOCs and HAPs emissions. While effective, these measures are not economically favorable due to high operating costs involving intensive resources and the formation of NO_x.

A novel composite made of activated carbon coated with a titania dioxide (TiO_2) photocatalyst used in an air pollution control system would allow for in-situ removal of VOCs and HAPs. This new composite uses UV light to regenerate the carbon in-situ via photocatalytic oxidation of the pollutants, which would require less energy and would not produce NO_x. In-situ regeneration would also minimize down time due to regeneration and would lower the energy requirements and costs associated with the current ex-situ regeneration technology.



Conceptual Diagram of the Carbon Bed and Regeneration System

Benefits

- *Energy use reduction*
- *$1.2 billion in cost savings to industry*
- *Lower operational maintenance*
- *No formation of NO_x*
- *Lower capital costs*

Applications

Once developed, the titania-activated carbon system can be used to remove VOCs and HAPs from air streams, replacing thermal oxidation systems that are currently being used by pulp, paper, paperboard mills and wood products facilities.

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Project Description

Goal: Develop a cost-effective and reliable air pollution control system to remove VOC and HAP emissions from pulp, paper, and paperboard mills, as well as solid wood products facilities.

The focus of the air pollution control system is a novel composite material of activated carbon coated with a photocatalyst titania dioxide (TiO_2). Activated carbons to be studied will include both commercially available carbons as well as those tailored to the target substrates by modification of surface chemistry and pore size distribution. Various wood waste materials (e.g., chips, saw dust, bark, etc.) make excellent sources of raw material for activation, and they will be collected and explored for their suitability for producing activated carbon. Upon optimization of the carbon for capacity and regeneration time using model compounds of interest, a pilot-scale system using the most effective materials in removing the target air contaminants will be designed, constructed, and tested. Field tests will be conducted at select facilities. Life-cycle analyses will be carried out to evaluate the environmental, energy, and economic advantages of the optimized system over traditional VOC and HAP control techniques currently used. The project will be accomplished through cohesive collaboration of all participating parties, who have generous experience in cutting-edge research and field work.

Progress and milestones

- Activated carbon has been shown to be effective in removing VOCs and HAPs from various sources, with effectiveness attributed to its high surface areas.
- Dr. Mazyck and Dr. Wu have shown simultaneous adsorption and destruction and in-situ regeneration using commercially available titania-coated carbon composites to purify water.

Project Partners

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Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

U.S. Department of Energy
Energy Efficiency and Renewable Energy

January 2004